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TO: John Ross, Senior Toxicologist **HSM-98001**
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FROM: David Haskell, Associate Environmental Research Scientist
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[original signed by David Haskell]

DATE: June 19, 1998

SUBJECT: Canada-United States Trade Agreement (CUSTA) Working Group, Final Draft of Position Paper for Issue Eight: Typical Workdays for Various Crops

Attached is a copy of the final draft of the position paper for Issue Eight, "Typical Workdays for Various Crops", that was given to the cooperating agencies Health Canada and the U S EPA for final review. The submission consisted of two tables: a). Average Acres Treated Per Full Workday For Various Crops and, b). Estimated Average Number Of Annual Workdays A Grower Or Employee of a Custom Applicator Applies Pesticides To A Specific Crop. These two tables will be included in a document that will summarize all the CUSTA issues. The values in the tables can assist the user in estimating the magnitude and frequency of the workday exposure for workers handling agricultural pesticides. Appendix A has been included to support the values listed in the two tables and to provide the user with background information.

POSITION PAPER

Issue Eight: Typical Workdays for Various Crops

Item #: One

Description: Methods Used to Estimate the Extent and Frequency of Workday Exposures for Pesticide Handlers

Current Agency Approaches:

California Department of Pesticide Regulation:
Extent of workday exposure for pesticide handlers is related to the amount of pesticide handled and the application method (Fenske, 1987; Franklin *et al.*, 1981; PHED, 1995). Studies submitted by registrants typically quantify this exposure by detecting the pesticide residues present on the worker with dosimeters during pesticide use. These studies usually include information on the application method and the number of acres treated per replicate or per workday for each worker. Sometimes an use survey may be conducted in conjunction with the study to quantify the extent of the pesticide use on a particular crop over the growing season. The California Department of Pesticide Regulation (DPR) uses this information and data to estimate the extent of the workday exposure from applying a pesticide with different types of application equipment and the frequency of specific applications during the use season.

However, most pesticide labels permit treatments to several different crops with various types of application equipment. The pesticide use information generated from one or a few studies may not be adequate to quantify the range of possible exposures from other uses permitted by the label. The Pesticide Handlers Exposure Database (PHED) is used to derive workday exposure estimates for specific application scenarios when actual data are not available. Estimates of the workday capacities (acres treated per workday) may also be taken from US EPA Reregistration Eligibility Decision (RED) documents and the Agricultural Pesticide Applicators Survey (WH&S Branch, 1996). Farm advisors may be contacted to characterize the pesticide use patterns for specific crops. This information can be used to estimate the annual frequency of a specific pesticide application. California's annual Pesticide Use Reports are employed to quantify the pesticide use on specific crops and the season of use. This information can also be used to estimate the number of annual days a specific treatment is made to a crop.

Health Canada:
The current approach for evaluating occupational exposure to pesticides is to obtain information from the registrant that describes the proposed use scenario and the human activity associated with its use. This information is part of the registration submission requirements and should include quantitative information that will help characterize exposure for workers mixing/loading and applying pesticides and for workers entering treated crops. The sources of information should be cited (e.g., label, growers groups, surveys, custom applicators, farm advisors, and associations) and to relevant to the types of end-users. All numerical values should be reported as fully as possible (e.g., min, max, mean). For workers mixing/loading and applying a pesticide,

the following items should be included; site of application, amount of crop that can be treated during one workday, timing of application, method of application and equipment used, tasks performed by worker making application and the personal protective equipment that will be worn. Information regarding the physical and chemical properties of the pesticide formulation that may influence exposure should also be included.

US EPA:

The Office of Pesticide Programs (OPP) uses information and data submitted by registrants to characterize the use pattern and to quantify the exposure for workers mixing/loading and applying pesticides and for workers entering treated crops. A use profile is conducted for each pesticide to identify the mechanism of action, use sites, formulation types, methods and rates of application and the estimated usage of the pesticide under the proposed registration. When pesticide specific exposure data are not available, the PHED database is used to derive generic estimates of dermal and inhalation exposure rates for various application scenarios. These exposure rates are expressed in micrograms of exposure per pound of active ingredient handled and can be customized according to the tasks performed by the worker. The Ng Program is then used to query a database of observed values for various parameters that define a pesticide application (equipment used, mix tank size, application speed, etc.) to derive estimates of the acres treated per workday. Estimates for the annual frequency of a workday exposure are derived from pesticide use patterns submitted by the registrant, government surveys, farm advisors and grower associations.

Harmonization Status:

All Agencies have agreed to use the default values listed in Table I to quantify the workday capacity for workers applying pesticides when pesticide specific application information is not available for a particular use pattern. However, Health Canada reserves the option to use values in it's Occupational Exposure Assessment Section (OEAS) for orchard and vegetable applications.

All Agencies have agreed to use the default values listed in Table II to estimate the annual frequency that workday exposure will occur when pesticide specific information is not available.

Detailed information regarding the sources of information and the methods used to compile and derive the values listed in these tables are presented in the document entitled "Consensus Paper to Establish Default Values for Quantifying Daily and Annual Exposure for Pesticide Handlers" in Appendix A.

TABLE I. AVERAGE ACRES TREATED PER FULL WORKDAY FOR VARIOUS CROPS

Crop Type	Application Equipment	Dilution Rate (gallons per acre)	Acres Treated per Workday	
			grower	custom applicator
Orchards-Vineyards	air blast	65	50	-----
	air blast	100-125	-----	40
	air blast	250	-----	35
	air blast	400-500	17	25
	air blast	750	-----	20
	air blast	1000-500	-----	15
	aerial fixed wing	20	-----	220
	aerial fixed wing	20	-----	430*
Vegetables	ground boom	25-35	80-100	-----
	ground boom	50	40-65	-----
	ground boom	75	-----	30-60
	ground boom	100	20	30-40
	ground boom	>100-200	-----	20
	helicopter	5	-----	175
	helicopter	5	-----	300*
	helicopter	10	-----	100
	helicopter	10	-----	170*
Field Crops	Ground Boom	5-9	350**	700-750**
	Ground Boom	10-12	175-250**	540**
	Ground Boom	30	-----	320**
	Ground Boom	35-40	100	200**
	Aerial Fixed wing	2-3	-----	1,000
	Aerial Fixed wing	5	-----	500
	Aerial Fixed wing	5	-----	1000*
	Aerial Fixed wing	10	-----	350
	Aerial Fixed wing	10	-----	700*

* Assumes two airplanes are working together to treat the same sites with one worker doing the mixing/loading for both planes. For helicopters, the assumption was made that two mixer/loaders were servicing one helicopter.

**Assumes the grower or employee of custom applicator is using a tractor equipped with state-of-the-art application technology; “closed” mixing/loading system, larger mix tanks, foam field marking system and extra wide spray boom.

Table II. Estimated Average Number of Annual Workdays a Grower or Employee of a Custom Applicator Applies Pesticides to a Specific Crop

Crops	Class of Pesticide	Highest % of Crop Reported Treated by Specific Pesticide (a)	Treatments per Season (a)	Annual Number of Application Days (b)	
				grower	custom app.
Corn	Fungicide	1	1	5	1
	Herbicide	65	1	5	18
	Insecticide	7	1	5	2
Cotton	Defoliant	23	1.5	8	10
	Fungicide	6	1	5	2
	Growth Regulator	19	1.5	8	8
	Herbicide	60	1	5	17
	Insecticide	26	2.5	13	18
Fall Potatoes	Desiccant	33	1.5	8	14
	Fungicide	65	3	15	55
	Herbicide	67	1	5	19
	Insecticide	24	1.5	8	10
Soy Beans	Fungicide	-----	1	5	1
	Herbicide	44	1	5	13
	Insecticide	1	1	5	1
Winter Wheat	Fungicide	1	1	5	1
	Herbicide	26	1	5	7
	Insecticide	2	1	5	1
Apples	Fungicide	51	3.5	14	54
	Growth Regulator	37	1	4	11
	Herbicide	25	1.5	6	-----
	Insecticide	77	2	8	46
Oranges	Fungicide	33	1.5	6	15
	Growth Regulator	6	1	4	2
	Herbicide	85	2	8	-----
	Insecticide	38	1	4	11
Peaches	Fungicide	40	2	8	24
	Herbicide	27	1.5	6	-----
	Insecticide	41	2.5	10	31
Broccoli	Fungicide	12	1	4	5
	Herbicide	57	1	4	23
	Insecticide	59	1.5	6	35
Watermelons	Fungicide	47	3	15	40
	Herbicide	15	1	5	4
	Insecticide	13	2	10	7

Table II. (con't)

Crops	Class of Pesticide	Highest % of Crop Reported Treated by Specific Pesticide (a)	Treatments per Season (a)	Annual Number of Application Days (b) grower	custom app.
Lettuce	Fungicide	48	1.5	6	29
	Herbicide	54	1	4	22
	Insecticide	78	2	8	62
Fresh Corn	Fungicide	31	3	12	26
	Herbicide	57	1	4	16
	Insecticide	53	6	24	89
Tomatoes (processed)	Fungicide	35	1.5	8	15
	Growth Regulator	21	1	5	6
	Herbicide	57	1	5	16
	Insecticide	39	1	5	11

a. Values were selected from the tables in the NASS surveys that summarize the pesticide use for the major producing states for a particular crop.

b. Values for the grower were calculated as the product of the base value (4 or 5 days) and the number of treatments per season. Values for the custom applicator were calculated as the product of the base value (28, 30 or 40 days), the percentage of the crop treated and the number of treatments per season.

APPENDIX A

CONSENSUS PAPER TO ESTABLISH DEFAULT VALUES FOR QUANTIFING DAILY AND ANNUAL EXPOSURE FOR PESTICIDE HANDLERS

Introduction

This paper represents a cooperative effort by Health Canada, U.S. EPA and California Department of Pesticide Regulation to share information and to derive a set of mutually acceptable default values that can be used to quantify the occupational exposure to agricultural pesticides when chemical specific data are not available. This exposure is expressed in terms of the magnitude of the daily exposure and the frequency this exposure occurs on an annual basis. The Issue Eight group concluded that "exposure per pound of active ingredient handled" was a better parameter for use in deriving point estimates for the magnitude of pesticide exposure than "exposure per hour of spray work". The magnitude of the workday exposure can be estimated as the product of the pounds of active ingredient (a.i.) handled and an empirically observed exposure rate (µg of exposure/lb of a.i. applied) or estimated from the Pesticide Handlers Exposure Database (PHED). The assumption is usually made when assessing acute health risks that pesticide applications are made at the maximum label rate which is a known value. The "acres treated per workday" becomes the unknown factor and is the focus for this issue. The pounds of a.i. applied per workday is then calculated as the product of the application rate and the number of acres treated per workday. One set of values (Table I) was compiled that estimate the number of "acres treated per workday" for various crop groupings (orchards-vineyards, vegetables, field crops) using different application methods. The frequency of the exposure is the estimated number of days per year a workday exposure is expected to occur. A second set of values was compiled that estimate the "annual number of application days" a class of pesticide is applied on various crops (Table II).

Acres Treated per Workday

The Issue Eight group analyzed pesticide application and use information gathered from agency reports (EPA Reregistation Eligibility Decision documents) and surveys, trade magazines and knowledgeable experts in the custom application industry to identify the parameters of a pesticide application (crop, application equipment, etc.) that limit pesticide applications on a daily basis. The crop, dilution rate, and the application equipment used were identified as the primary parameters that determine the maximum or optimum acres that can be treated during one workday (Haskell, 1996; SPUD, 1996). Secondary factors that can limit the optimum workday are equipment breakdowns, field conditions, weather changes, field size and the distance of water sources. Once the crop has been identified, then the type of application equipment and the dilution rate become the determining factors for the "acres treated per workday". Regarding application equipment, an orchard air blast sprayer was observed to have the least capacity with fixed-wing aircraft having the greatest capacity for the "acres treated per workday". The range of values compiled for workday capacity observed an inverse relationship between the "acres treated per workday" and the dilution rate when the crop and the application equipment remain the same. As the dilution rate increases, the workday capacity decreases. The observed values for "acres treated per workday" are categorized in Table I according to crop grouping, application equipment and dilution rate per acre.

The group observed that the workday capacities for the employee of the custom applicator were greater than for the grower. This is due in part to the more hours per workday devoted solely to making pesticide applications. For growers, pesticide applications are just one of many work tasks that need to be completed during the busy planting and growing season. However, for the ag-chemical supplier, the volume of sales of pesticides is due in part on the successful application during a limited use season. In the SPUD (1996) survey, farmers making herbicide applications to barley worked an average of 7.4 hours per day and the custom applicator employee averaged 11.7 hours per workday for the same treatment.

The difference in workday capacity for the custom applicator is also due in part to the more efficient equipment they use. The "acres treated per workday" for ground boom applications in Table I was derived with the assumption that a grower was using a conventional wheel tractor (open cab) equipped with saddle tanks, pump and a spray boom. There are, however, two additional types of specialized application equipment that have a much greater capacity than the traditional farm tractor. These spray rigs are most often used by farm chemical suppliers to apply pesticides and fertilizer sold by the company. Terra Gators® or truck mounted spray rigs with wide floatation tires are designed to apply liquid or dry formulations of pesticides and fertilizer to field crops planted without beds or early in the season before the rows are made. A second class of spray equipment are high-clearance tractors with mounted tanks and booms that are designed to treat crops planted in rows through most of the growing season. The spray booms can be raised to several feet in height to treat the crop at any stage of growth. Both types of specialized spray equipment have large mix tanks (500-1600 gallons) and wide spray booms (50-75 feet) that can greatly increase the "acres treated per workday" (Application Technology, 1995). For the barley herbicide applications listed in the SPUD (1996) survey, the grower averaged 232 acres per workday and the custom applicator employee 739 acres per workday. As a consequence, the values for the "acres treated per workday" in Table I were itemized separately for the grower and the employee of the custom applicator.

The Issue Eight group also observed that with ground boom equipment, the "acres treated per workday" were much greater for field crops than for vegetable crops for either the grower or the custom applicator employee. In the SPUD (1996) survey, growers applying fungicides averaged 65 acres per day for onions (54 gallon/acre dilution rate) and 131 acres per day for potatoes (39 gallon/acre dilution rate). Two sets of values were needed for ground boom applications to differentiate between treatments made to vegetable or field crops. Field crops (alfalfa, corn, cotton, etc.) permit the use of larger more efficient application equipment because the field sizes are much larger and generally only one crop per season is grown. Many field crops are planted without beds, which permit faster movement for application equipment. Field crops are often dry farmed so irrigation equipment and ditches are not hindrances for application equipment. Vegetable crops are generally grown with much smaller plantings (often 10-15 acres each) often with tight field conditions that limit the size of application equipment. Many different crops may be grown on one ranch that require different pest control programs which may require the spray equipment to be cleaned after each application. When several growers need the same crop treated at the same time, the custom applicator has to move equipment from ranch to ranch to continue spraying the same crop. A significant portion of the workday may be lost loading and moving spray equipment. These conditions limit the capacity of the application equipment used in vegetable crops and the number of acres that can be treated during one workday.

Table I has a range of possible values for the “acres treated per workday” which are related to the crop, the dilution rate and the type of application equipment used. These values are considered default values for use when actual data is not available for quantifying the workday day capacity. Each value is a relevant and reasonable estimate of the average acreage treated during a full workday. The registered crop uses and the designated pest combined with the recommended dilution rates and application equipment will be the limiting factors that decide which values are appropriate for use in estimating the “acres treated per workday” for a specific chemical.

TABLE I. AVERAGE ACRES TREATED PER FULL WORKDAY FOR VARIOUS CROPS

Crop Type	Application Equipment	Dilution Rate (gallons per acre)	Acres Treated per Workday grower	custom applicator
	air blast	65	50	-----
Orchards-Vineyards	air blast	100-125	-----	40
	air blast	250	-----	35
	air blast	400-500	17	25
	air blast	750	-----	20
	air blast	1000-500	-----	15
	aerial fixed wing	20	-----	220
	aerial fixed wing	20	-----	430*
Vegetables	ground boom	25-35	80-100	-----
	ground boom	50	40-65	-----
	ground boom	75	-----	30-60
	ground boom	100	20	30-40
	ground boom	>100-200	-----	20
	helicopter	5	-----	175
	helicopter	5	-----	300*
	helicopter	10	-----	100
	helicopter	10	-----	170*
Field Crops	Ground Boom	5-9	350**	700-750**
	Ground Boom	10-12	175-250**	540**
	Ground Boom	30	-----	320**
	Ground Boom	35-40	100	200**
	Aerial Fixed wing	2-3	-----	1,000
	Aerial Fixed wing	5	-----	500
	Aerial Fixed wing	5	-----	1000*
	Aerial Fixed wing	10	-----	350
	Aerial Fixed wing	10	-----	700*

* Assumes two airplanes are working together to treat the same sites with one worker doing the mixing/loading for both planes. For helicopters, the assumption was made that two mixer/loaders were servicing one helicopter.

**Assumes the grower or employee of custom applicator is using a tractor equipped with state-of-the-art application technology; “closed” mixing/loading system, larger mix tanks, foam field marking system and extra wide spray boom.

The values in Table I for the custom applicator employee and the enhanced values for the grower (field crops) were derived with the worker or grower operating specialized application equipment. These spray rigs use “closed systems” to directly inject measured quantities of the pesticide concentrate from the container into the carrier (water, fertilizer) in the mix tank. These direct injection systems can inject one to four different pesticides at the same time and are activated by electronic controls in the cab. The hand pouring of pesticides from an open container has been eliminated. All tractors have enclosed cabs to protect the operator from spray drift and leaks from hose failure. Foam marking systems are utilized to permit the applicator to mark treated portions of the field without leaving the cab. All these engineering features greatly reduce the risk of exposure to pesticides for the applicator. For workers operating this type of specialized application equipment, a 95% protection factor can be attributed for mixing/loading when a “closed system” is used (Thongsinthusak *et al.,* 1993). These spray rigs also have enclosed cabs that provide a 90-98% protection factor for the operator depending on whether the cab has a positive pressure filtration system (Thongsinthusak *et al.*, 1993). These protection factors should be used when deriving daily exposure estimates for workers mixing/loading and operating this specialized application equipment. Exposure data generated from the PHED database or studies conducted with conventional application equipment without these engineering controls should be reduced by 90-98%.

<u>Number of Annual Application Days</u>

The group reviewed the pesticide use information generated for field crops, fruits and vegetables from the surveys conducted by the United States Department of Agriculture, National Agricultural Statistics Service (NASS) (NASS. 1993; NASS, 1994; NASS, 1995). This information indicates all classes of pesticides (insecticide, fungicide, etc.) are not equally used to control pests and diseases for a specific crop. The annual presence of some pest problems like weeds require a herbicide to be used every growing season. The use of desiccants and defoliants have become part of the cultural practices for growing some crops and will normally be applied every season. However, the use of fungicides and insecticides is often in response to pest or disease outbreaks that may not occur every growing season or in every location the crop is grown. Much of their use is determined by unusual weather and unanticipated pest infestations. For corn, fungicides were rarely reported being used but 96% of the corn crop was reported receiving at least one herbicide treatment in 1995 (NASS, 1995). The type of pest problem may determine the probability that multiple applications of a class of pesticide may be required to attain satisfactory control during the growing season. For upland cotton, the most commonly used herbicide, trifluralin, was reported used an average of one once per season in 1995 (NASS, 1995). For this same crop, some insecticides were applied three and four times a season. These two observations related to percentage of the crop treated and frequency of multiple treatments are assumed to have an impact on the “annual number of application workdays”.

The minimum number of workdays per year required by a grower to make one pesticide treatment to a crop is relatively constant for all crops because each grower faces similar limiting factors. This application period is defined by the stage of growth of the crop, pest population, weather and the capacity of the application equipment. Each grower has to treat the whole crop or portions of the crop within a limited time period for optimum control of the pest. This treatment has to be completed in a timely manner to fit in with the sequence of cultural activities that will follow. Each grower will generally have application equipment that is appropriate for the size of his operation with the goal of consistently completing pesticide applications within a narrow window of application opportunity. If a grower has more acreage than he can treat in a timely fashion, he can contract to have a portion of it sprayed by a custom applicator or share the work with neighboring growers with the same crop. In a survey of Indiana farmers by the Indiana Farm Bureau, Inc., 52% of the growers reported they did all the herbicide spray work themselves (Pesticide & Toxic Chemical News, 1996). Another 24% indicated they contracted all the herbicide treatments to custom applicators. A third group of 24% reported doing half the work themselves and half was contracted out to custom applicators.

A minimum application period of four workdays was designated for a grower to make a pesticide treatment to a orchard, vineyard or fresh vegetable crop and five workdays for a field crop or vegetables harvested for processing. These base values are rough estimates based on limited information in the literature. These base value was then increased when pesticide use information for a specific treatment on a crop indicated that multiple treatments may occur during the growing season. The frequency of multiple treatments was estimated using pesticide use information from the NASS surveys. The number of treatments per crop was calculated as the average for the three chemicals with the highest percentage of reported use for each class of pesticides. Natural occurring chemicals like petroleum oils and sulfur were not used in the calculation.

The base value was increased for the personnel of custom applicators to reflect the fact that they can make the same treatment for several growers during the growing season. The length of this application season is related to the crops grown by their customers and the pests problems they incur. Many pesticide applications are part of the cultural practices for growing a crop and are scheduled to be made at a certain time or stage of crop growth. These treatments are usually made in anticipation of pest infestations based on historical occurrences. The time frames for optimum applications can be relatively long (weeks) like for preplant herbicides or short (days) like fungicide bloom sprays for stone fruits. Crop emergencies caused by unseasonable rain or sudden pest infestations can have very narrow windows of time when treatments have to be made before crop losses occur.

The Indiana Plant Food and Ag-Chem Association estimates that the corn crop in Indiana is usually planted in four weeks (Hyzer, 1996). The Indiana Agricultural Statistics Service (IASS) reported for the years 1991-1995, the “number of days suitable for field work” averaged 28 days for the months of April and May (IASS, 1995). Growers as well as custom applicators are constrained by weather and field conditions to not start planting or applying herbicides until the conditions are right. This 28 day period represents the application season for custom applicators when all preplant or preemergent herbicide applications to corn should be completed. Similar application seasons were estimated for orchard, vineyard and vegetable crops that relate to a specific stage of growth when pesticides are normally applied to control insect or disease problems. A 30 day period was identified for nut, pome, and stone fruits when various fungus and bacterial diseases can infect the crop during the bloom period. For vegetable crops that are planted one crop per season (carrots, onions, processing tomatoes, watermelons) and grown similarly to field crops, a 28 day application season was estimated for the custom applicator. And for other vegetable crops that are normally double cropped (broccoli, cauliflower, lettuce, etc.) and strawberries, a 40 day application season was estimated.

Table II has derived a series of estimates for the number of workdays per year growers and the employees of custom applicators apply a class of pesticide to a specific crop. These estimates of the "annual number of application days" for growers and custom applicators were generated as mean values for Canada and the United States. Unique pesticide use patterns may exist in individual states that may result in values that are greater or less than these mean values.

In general, the employees of custom applicators are expected to have more workdays per year applying pesticides than growers. The values for the "highest percentage of crop treated by specific pesticide" were taken from tables in the NASS surveys that summarize the fungicide, herbicide and insecticide use on a specific crop for the major producing states. The specific value from the NASS table represents the pesticide with the greatest percentage of the crop reported treated. The number of times a particular class of pesticides is applied per season to a crop was also estimated from the NASS data. This value was estimated by averaging the application frequency from the three most reported used pesticides for a particular class of pesticides. For example, with fall potatoes, the frequency of fungicide applications was estimated at three per year as the mean of the reported use for chlorothalonil (4.0 applications), mancozeb (3.4 applications), and metalaxyl (1.6 applications). This value for the frequency (three) was used to represent the frequency of use for fungicides in general on fall potatoes. For fungicides with less reported use, the use of this value to derive estimates of the "annual number of application workdays" will result in exaggerated estimates. For a few fungicides with more reported use than the average e.g., chlorothalonil, this method may result in a slight underestimate of use.

Table II. Estimated Average Number of Annual Workdays a Grower or Employee of a Custom Applicator Applies Pesticides to a Specific Crop

Crops	Class of Pesticide	Highest % of Crop Reported Treated by Specific Pesticide (a)	Treatments per Season (a)	Annual Number of Application Days (b)	
				grower	custom app.
Corn	Fungicide	1	1	5	1
	Herbicide	65	1	5	18
	Insecticide	7	1	5	2
Cotton	Defoliant	23	1.5	8	10
	Fungicide	6	1	5	2
	Growth Regulator	19	1.5	8	8
	Herbicide	60	1	5	17
	Insecticide	26	2.5	13	18

Table II (cont.). Estimated Average Number of Annual Workdays a Grower or Employee of a Custom Applicator Applies Pesticides to a Specific Crop

Crops	Class of Pesticide	Highest % of Crop Reported Treated by Specific Pesticide (a)	Treatments per Season (a)	Annual Number of Application Days (b)	
				grower	custom app.
Fall Potatoes	Desiccant	33	1.5	8	14
	Fungicide	65	3	15	55
	Herbicide	67	1	5	19
	Insecticide	24	1.5	8	10
Soy Beans	Fungicide	-----	1	5	1
	Herbicide	44	1	5	13
	Insecticide	1	1	5	1
Winter Wheat	Fungicide	1	1	5	1
	Herbicide	26	1	5	7
	Insecticide	2	1	5	1
Apples	Fungicide	51	3.5	14	54
	Growth Regulator	37	1	4	11
	Herbicide	25	1.5	6	-----
	Insecticide	77	2	8	46
Oranges	Fungicide	33	1.5	6	15
	Growth Regulator	6	1	4	2
	Herbicide	85	2	8	-----
	Insecticide	38	1	4	11
Peaches	Fungicide	40	2	8	24
	Herbicide	27	1.5	6	-----
	Insecticide	41	2.5	10	31
Broccoli	Fungicide	12	1	4	5
	Herbicide	57	1	4	23
	Insecticide	59	1.5	6	35
Watermelons	Fungicide	47	3	15	40
	Herbicide	15	1	5	4
	Insecticide	13	2	10	7
Lettuce	Fungicide	48	1.5	6	29
	Herbicide	54	1	4	22
	Insecticide	78	2	8	62
Fresh Corn	Fungicide	31	3	12	26
	Herbicide	57	1	4	16
	Insecticide	53	6	24	89
Tomatoes (processed)	Fungicide	35	1.5	8	15
	Growth Regulator	21	1	5	6
	Herbicide	57	1	5	16
	Insecticide	39	1	5	11

a. Values were selected from the tables in the NASS surveys that summarize the pesticide use for the major producing states for a particular crop.

b. Values for the grower were calculated as the product of the base value (4 or 5 days) and the number of treatments per season. Values for the custom applicator were calculated as the product of the base value (28, 30 or 40 days), the percentage of the crop treated and the number of treatments per season.

Discussion

The NASS reports represent a summary of the national pesticide use from one year for that class of crops. How representative the pesticide use information is from just one year's use is speculative. Pesticide use, particularly for fungicides and insecticides, can vary from year to year depending on the weather and pest populations. The continuation of the NASS surveys for several years would provide a more reliable source of information for deriving pesticide use generalizations. However, the pesticide use information in the NASS reports is similar to information reported by the California Department of Pesticide Regulation (DPR), Pesticide Use Reports for agricultural pesticides (DPR, 1995; DPR, 1996). In 1990, a program was initiated in California that requires all pesticide usage on agricultural crops to be reported on a monthly basis to the County Agricultural Commissioner. These county reports are then summarized for the entire state and reportedly annually in two formats; use summarized by commodity treated or by specific chemical. A comparison of the reported pesticide use by each report for selected crops is listed in Appendix I. The table indicates that California growers responding to the NASS survey tended to underestimate their pesticide use for most of the listed crops.

The values in Table I are not conservative estimates for the "acres treated per workday" for growers and the employees of a custom applicator. These values assume that each workday was dedicated singularly to applying one pesticide to one specific crop. For growers, there is a strong likelihood that only one crop will be treated per workday and the same pesticide or mix of pesticides will be used. However, the employee of a custom applicator may apply two-three different pesticides to control the same pest in a crop because growers may prefer different pesticides due to efficacy and cost concerns. Or due to the presence of different pest problems, the custom applicator employee may need to treat the same crop with different pesticides. Custom applicators and sometimes growers, treat more than one crop during a single workday. Due to these uncertainties, the actual number of "acres treated per workday" with a specific pesticide will probably be less than the estimated values in Table I, particularly for the employee of the custom applicator.

The values listed in Table II for the employee of the custom applicator may overestimate the annual number of application workdays for most classes of pesticides. The values for each combination of crop and class of pesticide are the product of a base value (28, 30 or 40 days), the number of treatments per season and the highest percentage of the crop reported treated with a specific pesticide. The value for the highest percentage of the crop reported treated with a pesticide was taken from the NASS survey with all other pesticides in the same class being used less. For example, atrazine had the highest reported usage for herbicide use in corn (65%). All other herbicides used on corn reported smaller percentages of the crop treated (1-29%).

Conclusion

This consensus paper represents an attempt by the three cooperating agencies to compile two sets of default values that estimate the “acres treated per workday” and the “annual number of application days”. These values can to used to derive an estimate of the magnitude of the workday exposure to pesticides and the annual frequency they occur. Attainment of this goal will help to harmonize the processes for evaluating occupational exposure to pesticides, which will permit pesticide exposure reviews and work to be shared among all agencies. When more definitive information becomes available on the use and application practices for agricultural pesticides, the sets of values can be revised to provide more accurate estimates of the workday capacity and the annual frequency of exposure.

References

Application Technology, 1995. Expanding application options-equipment shows break the mold. Published by Editors of Farm Chemicals magazine. Vol.3, # 5.

DPR, 1995. Pesticide use report-annual 1993 (indexed by commodity). DPR, Information Systems Branch.

DPR, 1996. Pesticide use report-annual 1994 (indexed by commodity). DPR, Information Systems Branch.

Haskell, D.1996 draft. Agricultural pesticide applicators survey to quantify daily capacity and annual exposure days to pesticides. DPR, WH&S Branch HS Report-1675.

Hyzer, C. 1996. Statistician for Indiana Plant Food and Ag-Chem Association. Personal conversation on April 12th with David Haskell.

IASS, 1995. Indiana agricultural statistics-summary of annual reports (1991-1995) for crop progress. Purdue University, West Lafayette, Indiana.

NASS, 1993. Agricultural chemical usage in fruits-1993 summary. U.S. Department of Agriculture, National Agricultural Statistics Service (NASS).

NASS, 1994. Agricultural chemical usage in vegetables-1994 summary. U.S. Department of Agriculture, National Agricultural Statistics Service (NASS).

NASS, 1995. Agricultural chemical usage in field crops-1995 summary. U.S. Department of Agriculture, National Agricultural Statistics Service (NASS).

PHED, 1995. Pesticide Handlers Exposure Database, Versar, Inc. Washington D. C.

SPUD, 1996. Statistics Pesticide Use Database by Health Canada.

Thongsinthusak, T., Ross, J. and Meinders, D 1993. Guidance for the preparation of human pesticide exposure assessment documents. DPR, WH&S Branch HS Report-1612.

U S EPA, 1994a. Reregistration eligibility decision for pronamide, Office of Pesticide Programs.

U S EPA, 1994b. Reregistration eligibility decision for bentazon, Office of Pesticide Programs.

U S EPA, 1995a. Reregistration eligibility decision for amitraz (draft), Office of Pesticide Programs.

U S EPA, 1995b. Reregistration eligibility decision for linuron, Office of Pesticide Programs.

U S EPA, 1995c. Reregistration eligibility decision for picloram, Office of Pesticide Programs.

U S EPA, 1995d. Reregistration eligibility decision for diquat dibromide, Office of Pesticide Programs.

U S EPA, 1996. Reregistration eligibility decision for trifluralin, Office of Pesticide Programs.

APPENDIX I

The following table is a comparison of pesticide use information generated by the NASS Surveys and California's DPR's 100% full pesticide use reporting program. The total pounds reported for each class of pesticide represent the total for three pesticides with the highest reported percentage of crop treated as indicated in the NASS survey for California. The reported total pounds used were compared as a ratio of the NASS use divided by the use reported in the DPR survey for the same crop and class of pesticide.

The NASS survey for 1993 reported pesticide use on tree fruits with individual California reports for citrus, pome and stone fruits. Very little use of fungicides were reported for oranges so this ratio was not calculated. The 1994 DPR report failed to include the usage of two important herbicides in broccoli (DCPA) and lettuce (pronamide) so a comparison was not calculated for these uses. As indicated in Table III, the calculated ratios are generally supportive of the NASS survey values. Most of the values in the DPR report are greater than those estimated in the NASS survey. This would be expected as the DPR reporting is required by regulation and participation in the NASS survey was voluntary.

Table III. Comparison of Pesticide Use on Various Crops in California As Reported by DPR Report and NASS Survey

Year or Report	Crop	Class of Pesticide	DPR Report (lbs. of a.i.)	NASS Report (lbs. of a.i.)	Ratio of NASS to DPR Use
1993	Oranges	Herbicide	529,201	308,600	0.58
		Insecticide	645,513	403,100	0.62
	Peaches	Fungicide	232,913	186,900	0.80
		Herbicide	59,498	36,600	0.62
		Insecticide	144,005	104,900	0.73
1994	Broccoli	Fungicide	28,607	29,100	1.02
		Herbicide	-----	200,400	-----
		Insecticide	139,309	109,000	0.78
	Lettuce (head)	Fungicide	745,499	434,300	0.58
		Herbicide	-----	72,400	-----
		Insecticide	338,985	246,100	0.73